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A MACHINE LEARNING-BASED MOBILE APPLICATION FOR DIABETES RISK EDUCATION

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Abstrak

Kegiatan pengabdian kepada masyarakat ini bertujuan untuk memperkenalkan aplikasi prediksi awal risiko diabetes berbasis machine learning sekaligus mendampingi Kader Surabaya Hebat, dalam memanfaatkan teknologi untuk edukasi warga. Pelaksanaan program menerapkan pendekatan partisipatif melalui koordinasi dengan mitra, pengumpulan informasi kesehatan dasar, pengembangan aplikasi, sosialisasi, pelatihan, serta uji coba bersama pengguna. Dokumentasi kegiatan menunjukkan tersedianya aplikasi dengan menu utama, materi edukasi, dan formulir identifikasi risiko; media pembelajaran digital; serta keterlibatan kader dalam kegiatan pendampingan. Laporan pelaksanaan juga mencatat penerimaan positif dari mitra, meskipun belum menyajikan data terukur mengenai peningkatan pengetahuan, jumlah peserta, maupun kinerja model prediksi. Karena itu, hasil artikel dibatasi pada luaran dan proses penerapan yang terdokumentasi, bukan pada efektivitas klinis atau akurasi diagnostik. Kontribusi utama kegiatan ini terletak pada penyediaan media edukasi kesehatan digital berbasis machine learning yang dapat dimanfaatkan kader sebagai sarana pendukung identifikasi awal risiko diabetes dan peningkatan literasi kesehatan masyarakat.

Kata kunci: *Kader Kesehatan; Pengabdian Masyarakat; Literasi Kesehatan; Risiko Diabetes; Machine Learning.*

Abstract

Digital systems at the community level can help community health volunteers deliver health information more systematically. This community service program aimed to introduce a machine learning-based application for preliminary diabetes risk prediction and to support the Surabaya Hebat health volunteers in using technology for community education. The program adopted a participatory approach involving partner coordination, collection of basic health information, application development, outreach, training, and user testing. The activity documentation describes an application with a main menu, educational materials, and a risk identification form, along with digital learning resources and volunteer mentoring. The implementation report also notes a positive response from partners, but it does not provide measurable data on knowledge gains, participant numbers, or the predictive model's performance. Accordingly, the findings are limited to documented outputs and implementation processes rather than clinical effectiveness or diagnostic accuracy. The program's main contribution is a machine learning-based digital health education tool that community health volunteers can use to support preliminary diabetes risk identification and improve community health literacy.

Keywords: Community Health Volunteers; Community Service; Health Literacy; Diabetes Risk; Machine Learning.

INTRODUCTION

Diabetes mellitus is a public health concern that requires attention to risk awareness, access to screening, and sustained education (Chandrasekaran et al., 2024). The International Diabetes Federation, (2025) estimated that approximately 20.4 million adults aged 20–79 years were living with diabetes in Indonesia in 2024. The World Health Organization, (2024) emphasizes the importance of detection through blood glucose testing, alongside prevention and management supported by adequate health information. Health volunteers play an important role in connecting residents with educational activities and health services (Rattanadachakul et al., 2025). This role becomes particularly relevant when some residents face time constraints or difficulties accessing routine examinations (Dahal et al., 2023). Communicating disease risks requires clear language and supporting tools suited to users' capabilities. Predictive technology may support this communication, provided that its outputs are not treated as medical diagnoses (Gardner et al., 2025).

However, despite the growing recognition of digital health technologies and community-based prevention strategies, a gap remains between their potential benefits and their practical implementation at the community level (Endalamaw, et al., 2025). In many community settings, health education and early risk identification still depend heavily on conventional counseling, periodic screening activities, and the availability of trained health personnel (Armiani et al., 2021; Imelda et al., 2025). Digital applications do not automatically resolve these challenges, as successful implementation also depends on users' digital literacy, ease of data entry, and the ability to interpret the information generated (Narayan et al., 2026). A study of community health workers across multiple countries highlighted both the potential of digital health tools and the need to address implementation barriers to ensure effective use (Blondino et al., 2024). Research on digital screening applications among community health volunteers in Vietnam identified limited digital literacy, insufficient previous experience, and difficulties in data completeness as important barriers to implementation (Thach et al., 2025). These findings indicate that digital tools alone are insufficient; introducing technology should be paired with practical training, user support, and contextual adaptation.

The community service team combined the development of a machine learning-based application with knowledge-transfer activities for health volunteers. Basic health information was used as input to generate preliminary risk categories, while educational materials and mentoring sessions were intended to help users understand the application's functions, limitations, and appropriate follow-up actions. The program was not intended to replace blood glucose measurements or examinations by health professionals. The integration of machine learning into community-based health education is supported by the growing recognition of digital decision-support technologies as tools for improving access to health information and facilitating risk awareness. Risk assessment based on demographic

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and health-related factors can help identify individuals who may benefit from further screening and preventive interventions (Gali et al., 2026). However, risk prediction should be distinguished from clinical diagnosis, as the diagnosis of diabetes requires established laboratory-based criteria, including glycated hemoglobin (HbA1c) or plasma glucose measurements (Wang et al., 2023). The application of artificial intelligence in healthcare should prioritize transparency, human autonomy, accountability, and safety (Rong et al., 2025). These principles underscore the need to provide adequate training and mentoring to community health volunteers so they can communicate predictive information responsibly, recognize technological limitations, and guide residents to appropriate health services. Therefore, combining digital applications with structured knowledge-transfer activities is an important implementation strategy to ensure that technological innovations contribute meaningfully to community health promotion.

Previous community service initiatives have highlighted the importance of digital technology in strengthening community health education and supporting health volunteers (Rajesh et al., 2025). Several programs have introduced digital health information systems, mobile health applications, and technology-assisted educational media to raise public awareness and improve access to health information (Durlik, et al., 2024). Other community-based initiatives have focused on improving volunteers' knowledge and skills through health education, training, and mentoring activities (Mustikaningsih et al., 2025). These approaches show that integrating digital tools into community health programs can make health education more accessible and structured. However, implementing digital health education still requires attention to local communities' specific needs, health volunteers' digital competencies, and the practical relevance of the technology being introduced.

This community service program is novel in integrating a machine learning-based preliminary diabetes risk identification application with participatory education and digital capacity-building for community health volunteers. Unlike community service activities that primarily emphasize health counseling or the dissemination of digital educational materials, this program combines an interactive risk-identification feature, diabetes education content, and direct mentoring to help volunteers use technology as an educational tool. Furthermore, the application introduces technological innovation while connecting it to the real needs of community-level health education. This integrated approach offers a practical model for introducing accessible machine learning technology into community health promotion while emphasizing that preliminary risk categories are educational aids, not clinical diagnoses.

This community service purposed (1) how the partner's needs were translated into an application design and community service activities; (2) what outputs and forms of participation were documented; and (3) what evaluation

components should be addressed so that subsequent implementation can be assessed more objectively. This emphasis distinguishes the community service article from a technical report on algorithm development.

MATERIALS AND METHODS

Location, Partner, and Program Design

The program formed part of the 2025 Higher Education Grant activities at Universitas 17 Agustus 1945 Surabaya. The partner location was RW 4, Medokan Semampir, Surabaya, and the principal target groups were local health volunteers and residents who attended outreach sessions. The source documents do not report the final number of participants, specific dates for each session, or aggregate participant characteristics; these details have not been added by assumption.

The implementation approach was participatory: volunteers were involved in needs exploration, assisted information collection, application-use training, and communication with residents. The activity stages were sequenced so that the innovation could be introduced within the volunteers' actual work context rather than merely demonstrated as a technology product based on Table 1.

Table 1. Stages of Program Implementation

Stage	Activities described in the report	Available outputs/evidence
Coordination	Discussions with volunteers and stakeholders; preparation of plans and instruments.	Problem identification and design of the program workflow.
Initial survey	Collection of residents' basic characteristics and health information with volunteer assistance.	List of input variable types; individual records not presented.
Development	Integration of a machine learning model into a simple application.	Documentation of the application interface and service workflow.
Outreach	Introduction to diabetes risks and demonstration of system use.	Activity photographs and reports of volunteer participation.
Evaluation/follow-up	Field testing and sustainability planning.	Qualitative evaluation narrative; measurable indicators not yet reported.

Information Collection and Application Development

The report describes using basic health characteristics, including age, sex, weight, height, body mass index, blood pressure, and family history of diabetes. The team planned to use, or used, these variables as model inputs and to display risk levels in easily understood categories. Some sections of the report mention decision

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tree or random forest as alternative algorithms, but there is no final explanation of the selected algorithm, training–test split, dataset size, hyperparameter settings, or confusion matrix. Consequently, this article does not identify either algorithm as the final implementation or report unsupported accuracy values. The documented application interface includes a home page, a diabetes education page, and a risk identification form. The form estimates risk based on user-supplied information. The resulting risk categories should be presented as preliminary information for discussion and follow-up, not as a determination of disease status.

Outreach, Training, and Mentoring

The technology introduction was accompanied by education about diabetes and the importance of health examinations. Under the program design, volunteers received guidance on entering data correctly, interpreting application outputs, and helping residents understand recommendations for further examinations. The team prepared digital posters, electronic leaflets, and short videos to support information dissemination. The report records the availability of these materials but does not specify their distribution coverage or number of recipients.

Volunteer involvement was positioned as central to empowerment. Volunteers helped establish communication with residents, supported field activities, and linked application use with available health services. This approach offers opportunities for continued implementation, particularly if operating procedures, technical assistance, and referral mechanisms are agreed upon with health professionals.

RESULTS AND DISCUSSION

The report's main output is a diabetes education application and preliminary risk identification. Its design combines informational content with a workflow for entering health data. This integration is important in empowerment activities because presenting predictive results without explanation may lead to misinterpretation. A simple interface is also relevant for volunteers with varying levels of digital experience as described in Figure 1.

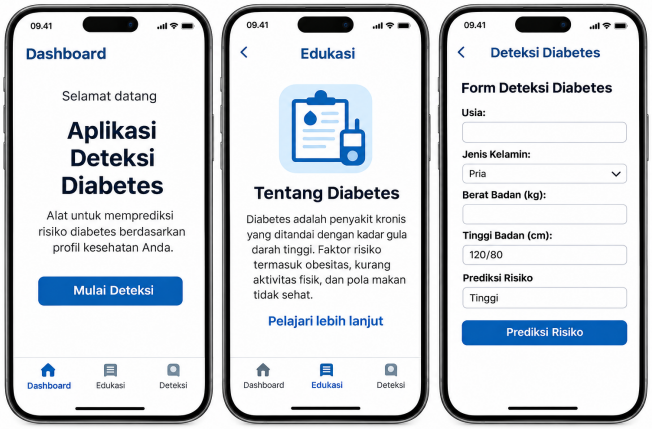


Figure 1. Mobile Application for Diabetes Risk Identification

The interface documentation in Figure 1 demonstrates navigation, educational content, and data-entry functions. However, screenshots establish only the system design or appearance; they do not demonstrate clinical validation of the model. Likewise, claims that the application is easy to use still require support from measurable usability testing among health volunteers.

The supporting products mentioned include training modules and digital content such as posters, leaflets, and videos. In community service activities, these resources provide opportunities to reinforce educational messages after face-to-face sessions have ended. To support replication, future publications should include examples of the materials, distribution procedures, and mechanisms for updating content reviewed by health professionals.

Implementation with Volunteers and Residents

The report states that outreach and mentoring took place in the partner community. Volunteers attended the activities and helped facilitate interactions with residents, including collecting information and using the application hands-on. Visual documentation shows face-to-face sessions with volunteer representatives. These field activities strengthen the program because the technology was introduced in users' real environment rather than solely through laboratory simulations based on Figure 2.



Figure 2. Outreach Session on the Diabetes Risk Application

Volunteer participation created opportunities for learning by doing. In this approach, volunteers not only received information but also interacted with the application and helped residents understand how to use it. Although the report mentions community enthusiasm, the scale of participation cannot be established from photographs or narrative descriptions; attendance numbers and training completion rates should be reported separately if data are available.

The implementation documents identify three benefits: introducing technological skills to volunteers, communicating diabetes risk information to residents, and providing educational tools that can be used in community activities. These may appropriately be reported as implementation outputs or the implementing team's perceptions. However, no instruments are available to establish specific improvements in participants' knowledge, changes in screening behavior, or reductions in diabetes incidence. This limitation matters because the term early detection could imply that the application provides a diagnosis. In fact,

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information derived from non-laboratory data should more appropriately be treated as a preliminary risk estimate or screening aid requiring follow-up according to health professionals' recommendations.

The implementation of the diabetes risk application produced several outputs that can be identified from the program documentation, including the development of a mobile application, the delivery of educational materials, and the involvement of community health volunteers in outreach and mentoring activities. These outputs demonstrate that the program was implemented through a combination of technological development and direct community engagement. The volunteers' participation and the positive responses described in the implementation report indicate initial acceptance of the activities, although these observations should not be interpreted as measurable improvements in knowledge, digital skills, or health behavior. Furthermore, the available documentation does not provide quantitative evidence of predictive model accuracy, clinical validity, or changes in diabetes-related health outcomes. Therefore, the interpretation of the program results needs to distinguish between documented implementation outputs, qualitative observations, and outcomes that have not yet been empirically evaluated. A summary of the implementation components, supporting evidence, and the extent to which conclusions can be drawn from the available documentation is presented in Table 2.

Table 2. Implementation of the Diabetes Risk Application

Result component	Evidence in the report	Interpretation supported by the evidence
Application	Application interface and feature descriptions.	A digital product is available at the level documented.
Field activities	Outreach photographs and training narrative.	Mentoring activities were conducted.
User responses	Descriptions of volunteers' and residents' enthusiasm.	Qualitative observations by the team, not satisfaction scores.
Predictive accuracy	General statements about the model; no testing table.	No accuracy value or clinical validity can be inferred.
Health impact	No pre–post or follow-up data.	Effects on behavior and health have not been measured.

Program Sustainability

The program's primary value lies in connecting volunteers' needs with data-informed educational tools. For volunteers, the application may serve as a conversation aid that encourages residents to ask about risk factors and the importance of screening. For the university team, partner involvement from the

outset enables the design to be improved in response to real-world circumstances. This relationship between the team and its partner could be strengthened in similar community service programs. Program sustainability requires clear divisions of responsibility. With residents' consent, volunteers can facilitate education and assist with data entry; the development team can manage software updates and testing documentation; and health professionals can advise on further examinations and treatment.

Priorities for Strengthening Evaluation in Future Implementation

Before wider implementation, the program needs to distinguish between two evaluation pathways. Community service evaluation assesses changes in knowledge and application-use skills among volunteers or residents. Technology evaluation examines whether the model makes consistent predictions on representative data and whether its outputs are safe to use in the intended context. Success in one pathway does not automatically establish success in the other.

To ensure the quality, accountability, and sustainability of future implementation, a more systematic evaluation framework is required to assess both the community empowerment outcomes and the technical performance of the application. Community service evaluation should focus on measurable indicators, such as participant coverage, changes in knowledge, improvements in volunteers' digital skills, and the usability of the application. Meanwhile, technology evaluation should examine the quality and representativeness of the input data, model validation procedures, predictive performance, calibration, and information security to ensure that the application operates responsibly within its intended context. In addition, sustainability indicators, including the continuity of mentoring activities, regular application maintenance, and monitoring of volunteer engagement, are necessary to assess the potential for long-term adoption. Since the 2025 implementation report does not provide complete quantitative measurements for these aspects, the proposed indicators should be considered priorities for subsequent program development and evaluation rather than demonstrated achievements. The recommended evaluation aspects, measurement instruments, and their availability in the 2025 implementation report are summarized in Table 3.

Table 3. Recommended Program Evaluation Indicators

Aspect	Recommended indicator/measurement tool	Status in the 2025 report
Coverage	Number of participants, number of volunteers, and attendance rate.	Not specified.
Knowledge	Scores from brief pre- and post-training questionnaires.	Not provided.
Skills	Observation of data entry and result interpretation.	Described narratively; not measured.
Application usability	Usability questionnaire and records of input errors.	Not available.

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Aspect	Recommended indicator/measurement tool	Status in the 2025 report
Model performance	Data source, sample size, validation, metrics, and calibration.	Not reported in detail.
Information security	Consent, data minimization, access control, and retention.	Requires documentation.
Sustainability	Mentoring schedule and monitoring of application use.	Still a recommendation.

The mobile application aims to integrate machine learning technology with community-based diabetes education. Combining educational materials with preliminary risk-identification functions creates an opportunity to communicate health information more interactively than conventional information dissemination. This integration is particularly relevant because digital health interventions can improve access to health information and support preventive health practices when designed around users' needs (Zhuang et al., 2025). Previous research has also shown the potential of machine learning approaches to identify individuals at risk of type 2 diabetes, although practical application depends on input data quality and appropriate model validation (Veluvali et al., 2025). In this program, the application should therefore be understood as an educational, preliminary risk-identification tool rather than a clinically validated diagnostic system. It makes basic health information more accessible to volunteers and residents while creating opportunities for further health discussions and appropriate screening referrals.

Introducing the application through direct training and mentoring is an important part of the program because access to digital technology does not guarantee effective adoption. Community health volunteers may have different levels of digital literacy, technological experience, and confidence in using mobile applications. Consequently, application design needs to consider simplicity, accessibility, and the practical capabilities of intended users. Previous studies have identified digital literacy, perceived usefulness, and ease of use as important factors influencing technology acceptance and utilization (Ai et al., 2025). Involving community health workers in digital health interventions requires adequate training, ongoing support, and contextual adaptation to overcome implementation barriers (Santos et al., 2025). The participatory training approach adopted in this program gives volunteers an initial opportunity to become familiar with application functions through direct interaction. Nevertheless, structured usability assessments, such as the System Usability Scale (SUS), supported by observations of task completion and input errors, should confirm the claim that the application is user-friendly (Hyzy et al., 2022).

Surabaya Hebat health volunteers' involvement in outreach and mentoring activities demonstrates the importance of community participation in introducing digital health innovations. Rather than positioning volunteers solely as recipients of

health information, the program encouraged them to use the application and communicate with residents. This approach aligns with community engagement principles, in which local stakeholders contribute to the implementation and sustainability of health interventions (Narayan et al., 2026). Complementary educational resources, including posters, leaflets, and videos, also reinforce messages beyond face-to-face training sessions. Evidence from health communication research suggests that appropriately designed educational materials can support the delivery and reinforcement of health information, although their effects depend on content quality, audience characteristics, and implementation strategies (Endalamaw et al., 2025). In this program, these materials represent supporting educational outputs rather than evidence of improved health literacy. Future implementation should therefore assess participants' understanding through pre- and post-education questionnaires and document how often volunteers use the materials in subsequent community activities.

An important consideration emerging from this program is the distinction between successfully introducing an application and demonstrating its predictive reliability or health impact. Although machine learning offers opportunities for diabetes risk prediction, interface documentation or descriptions of application functionality alone cannot establish its performance. Chandrasekaran et al., (2024) found promising predictive performance across machine learning models for type 2 diabetes in community settings, but also noted a lack of external validation and methodological limitations that limited broader implementation. The American Diabetes Association Professional Practice Committee (2025) also establishes laboratory-based criteria for diabetes diagnosis, reinforcing the distinction between preliminary risk assessment and clinical diagnosis. Accordingly, the application developed in this program should be positioned as a supporting educational tool that encourages awareness and appropriate referral rather than an alternative to blood glucose testing or professional medical assessment. Future evaluation should include model validation, discrimination, calibration, data quality assessment, and usability testing before the application is considered for wider deployment.

The sustainability of this community service initiative depends on maintaining collaboration between the university, community health volunteers, and local health professionals. Volunteer involvement creates an opportunity to integrate the application into existing community education activities, while continued technical support is necessary to maintain functionality, update educational materials, and address potential operational issues. This collaborative approach is consistent with the World Health Organization's (2020) framework for community engagement, which emphasizes meaningful stakeholder participation in developing and maintaining health promotion initiatives. Evidence from Santos et al., (2025) further indicates that digital health training is positively associated with the use of digital

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tools and community health workers' perceptions of their potential impact. Wang et al., (2023) demonstrates the importance of community engagement in improving the implementation of public health interventions, particularly among underserved populations. Based on these considerations, future program development should establish regular mentoring schedules, clearly defined responsibilities for application maintenance, procedures for protecting personal health information, and routine monitoring of volunteer participation. Evaluation should also include measurable indicators, such as training attendance, changes in knowledge, application usability, and validated model performance. Such improvements would provide a stronger evidence base for assessing the program's sustainability and determining its potential for replication in other community settings.

CONCLUSIONS AND SUGGESTIONS

The community service program using a machine learning-based application for diabetes education and preliminary risk identification in RW 4, Medokan Semampir, Surabaya, was implemented through outreach, training, and mentoring for health volunteers. The program produced an application designed to help residents recognize diabetes risk factors using basic health information while providing educational resources on the importance of early identification and disease prevention. Machine learning technology also creates opportunities for health volunteers to integrate digital tools into community health services. With a simple interface and guided use, the technology can support health education in Posyandu (integrated community health posts) and other community health activities.

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